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**Sampling and Analysis Plan To
Support Recommendation for No Further Investigation
at Tank Farm #4 (PRL T-18)**

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DEC 26 1995



**McCLELLAN AIR FORCE BASE
CALIFORNIA**

Prepared for

**Air Force Center for Environmental Excellence
Brooks Air Force Base, Texas**

and

**Environmental Management
McClellan Air Force Base, California**

December 1995

Prepared by

PARSONS ENGINEERING SCIENCE, INC.

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**SAMPLING AND ANALYSIS PLAN TO SUPPORT
RECOMMENDATION FOR NO FURTHER INVESTIGATION**

at

**TANK FARM #4 (PRL T-18)
MCCLELLAN AIR FORCE BASE, CALIFORNIA**

Prepared for

**Air Force Center For Environmental Excellence
Brooks AFB, Texas
and
Environmental Management
McClellan Air Force Base, California**

December 1995

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
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SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

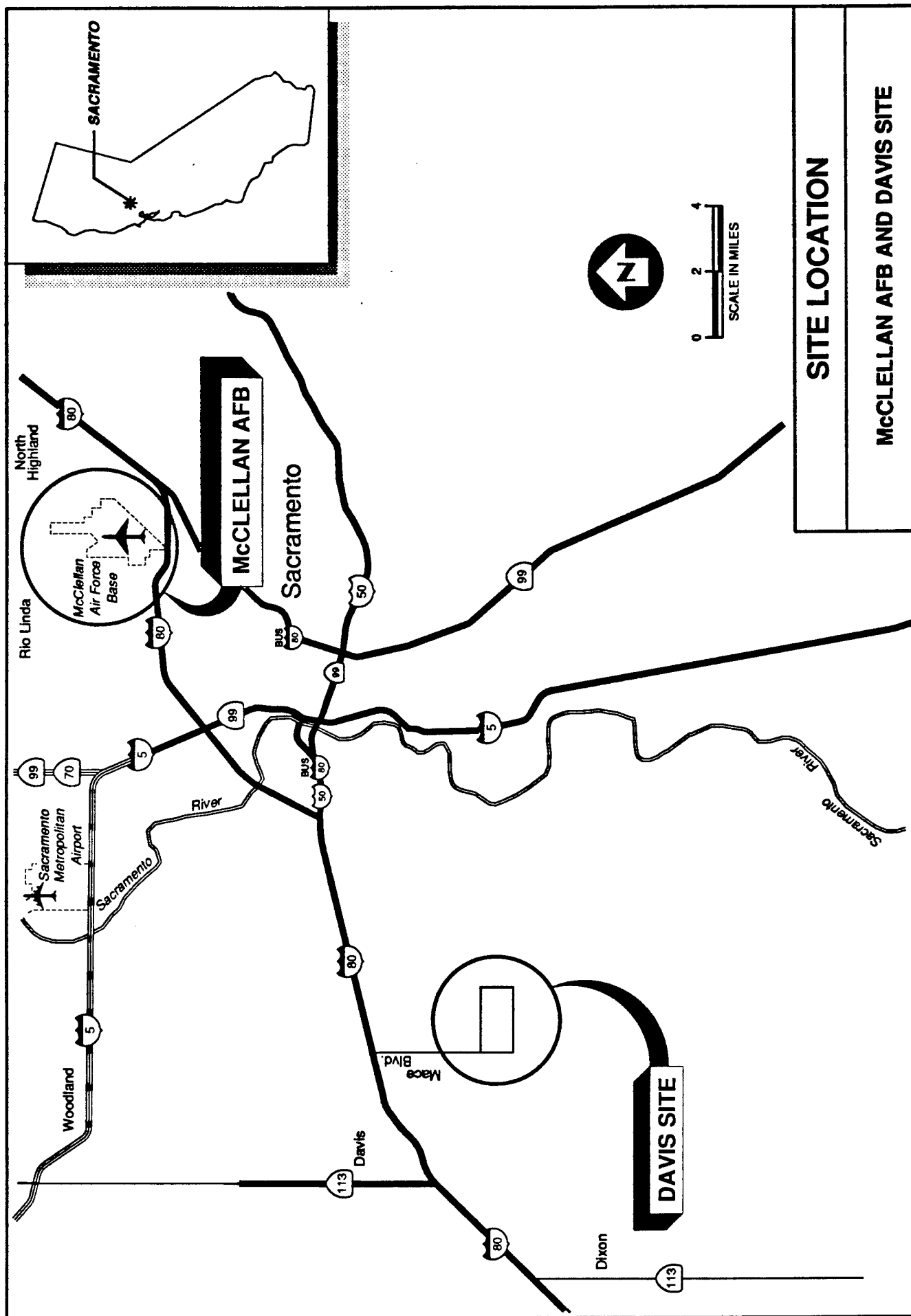
This sampling and analysis Plan (SAP) presents the proposed scope of work to be conducted at the former Tank Farm #4 site at McClellan Air Force Base (AFB), Sacramento County, California. It is anticipated that the analytical results from the proposed sampling will support a no further investigation (NFI) recommendation for this site. This SAP has been prepared by Parsons Engineering Science, Inc. (Parsons ES) for submittal to the Regional Water Quality Control Board (RWQCB) and the Department of Toxic Substances Control (DTSC). This SAP follows the recommendations for the site in the OU A Phase I Remedial Investigation (RI) and Site Characterization Summary (SCS) report (Jacobs 1995).

McClellan AFB is located near Sacramento, California, approximately 100 miles northeast of San Francisco (Figure 1.1). Tank Farm #4, also designated as Potential Release Location T-18 (PRL T-18), is the former location of a truck filling stand and is located in Operable Unit A (OU A) (Figure 1.2).

McClellan AFB has participated in the U.S. Air Force Bioventing Pilot Test Initiative, sponsored by the Air Force Center for Environmental Excellence (AFCEE) at Brooks AFB, Texas. The initiative included conducting more than 135 *in situ* pilot tests at 48 Air Force installations throughout the country. These tests were designed to collect data on the effectiveness of bioventing for the remediation of soil contaminated with fuel hydrocarbons (e.g., jet fuel, diesel fuel, gasoline, heating oil). One-year long bioventing pilot tests were completed as part of this initiative at 4 sites at McClellan AFB (Figure 1.2), including Tank Farm #4, and one site at the Davis Global Communications Site (Figure 1.1). Review of the results from the bioventing pilot test and the OU A RI/SCS at Tank Farm #4 resulted in preparation of this SAP.

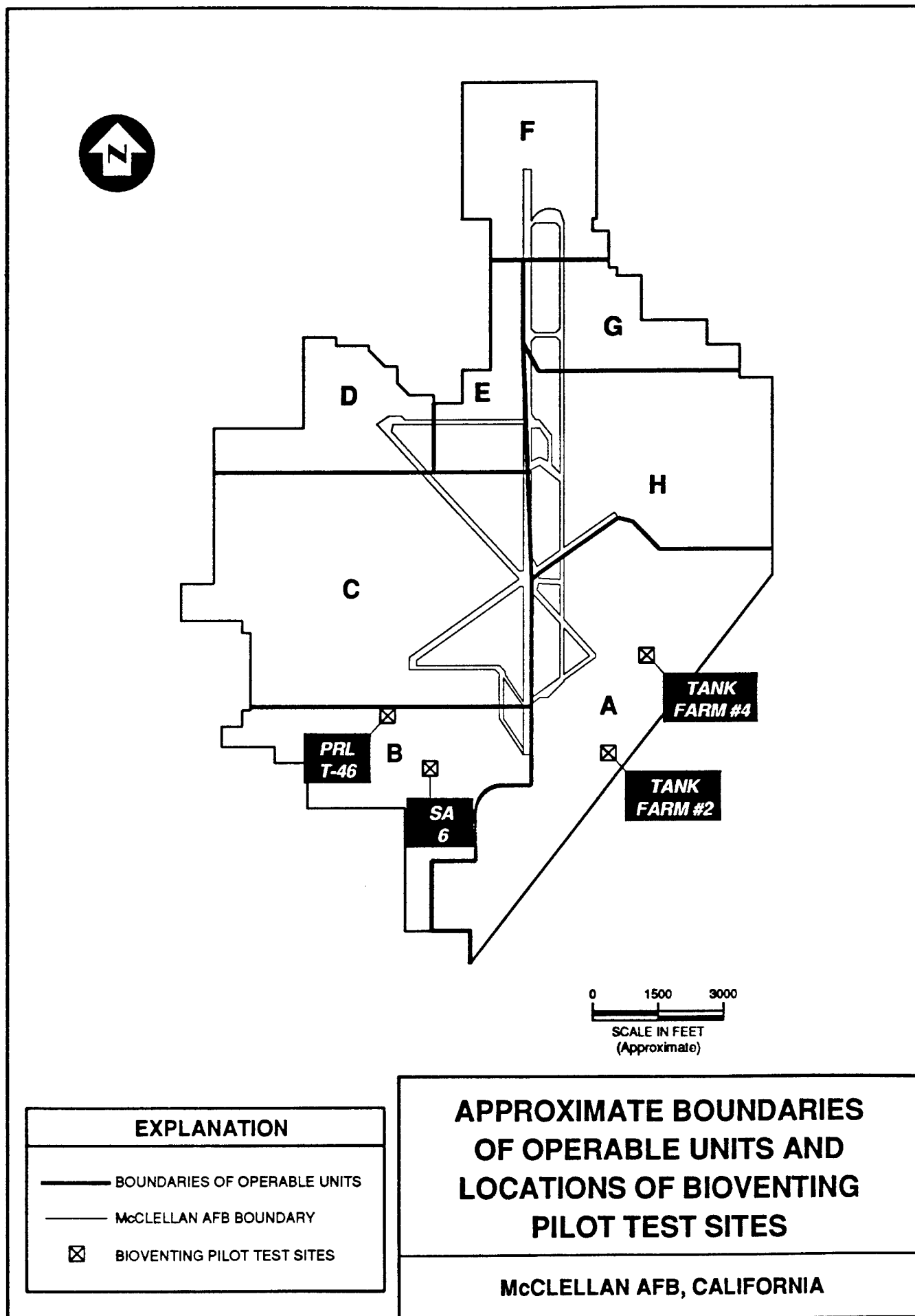
This SAP consist of six sections, including this introduction, and one Appendix. Section 2 includes site descriptions, histories, and summaries of previous investigations and remediation activities. Section 3 includes the proposed sampling and analysis plan. Analytical results from the sampling activities will be presented in a Letter Report as described in Section 4. A proposed schedule for the sampling activities and submittal of the Letter Report is included in Section 5. Section 6 provides references cited in this SAP. Appendix A includes the soil boring logs completed as part of previous remedial investigations.

FIGURE 1.1



SITE LOCATION	
McCLELLAN AFB AND DAVIS SITE	

FIGURE 1.2



SECTION 2

SITE DESCRIPTION AND HISTORY

SECTION 2

SITE DESCRIPTION AND HISTORY

2.1 SITE LOCATION AND HISTORY

2.1.1 McClellan AFB

McClellan AFB is located approximately 7 miles northeast of downtown Sacramento and covers approximately 3,000 acres (Figure 1.1). Employing approximately 15,000 civilian and military personnel, the base provides worldwide logistics support for weapons systems, equipment, and commodity items as well as maintenance, supply, and contracting services. The base was established in 1936 and since that time has managed, maintained, and repaired various aircraft, electronics equipment, and communications equipment. These operations have generated various hazardous and toxic wastes, including: industrial solvents, electroplating wastes, heavy metals, PCB contaminated oils, jet fuels, and a variety of oils and lubricants.

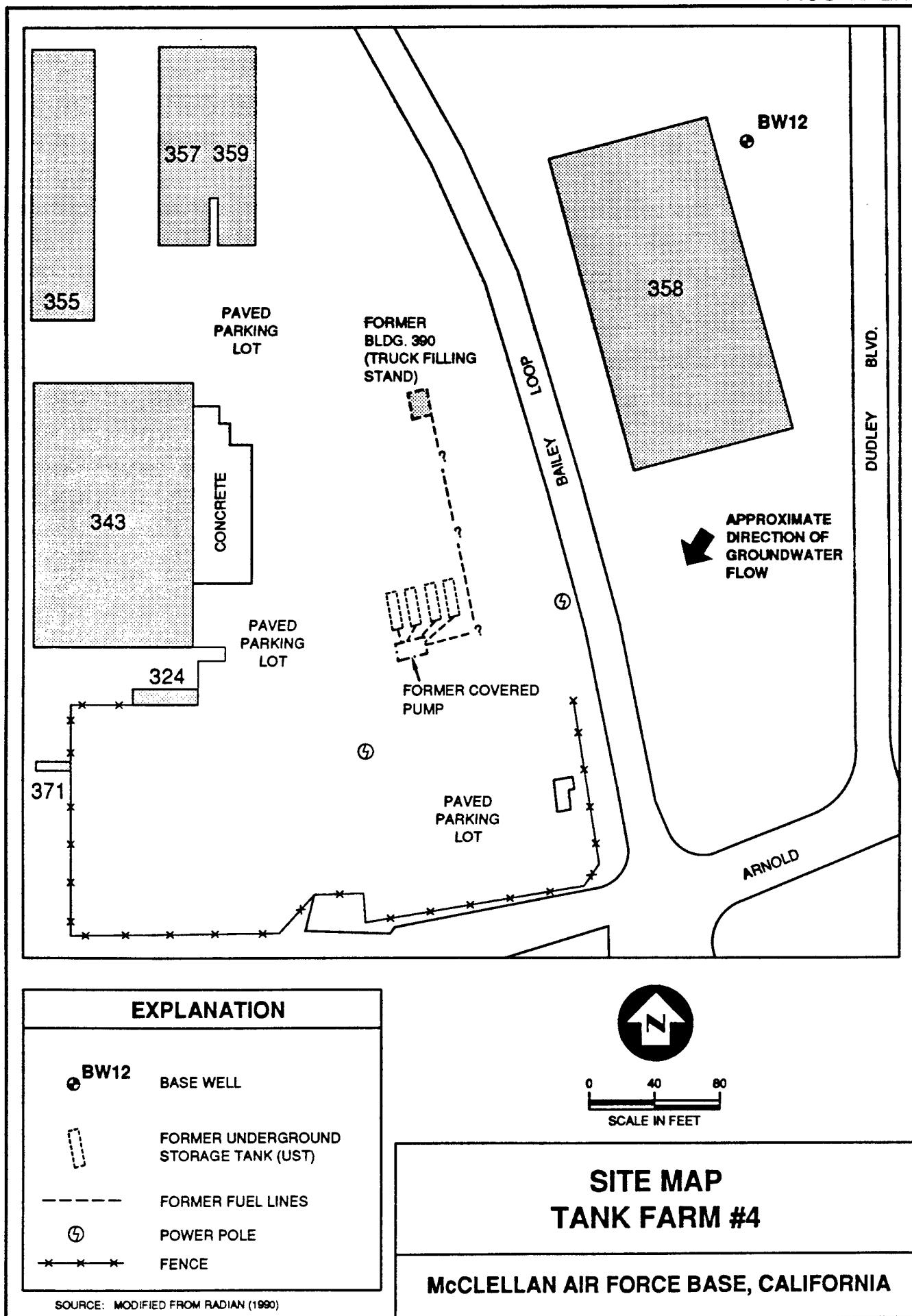
Hazardous wastes were disposed of at a variety of burial pits, sludge pits, and miscellaneous disposal trenches and pits. In 1979, groundwater contamination was discovered and subsequently base production wells were shut down. Since that time, base production wells have been retrofitted with treatment systems, numerous monitoring wells have been installed, and three groundwater extraction systems have been installed to prevent migration of contaminants. A groundwater treatment plant was constructed in 1985.

Numerous environmental investigations have been performed throughout McClellan AFB as part of the U. S. Air Force (USAF) Installation Restoration Program (IRP). Possible sources of contamination at McClellan AFB identified in prior studies are grouped by geographic area, designated as Operable Units (OU) A through H (Figure 1.2). Each OU was further broken down into geographic investigation clusters (IC) comprised of multiple sites. An additional OU separately addresses groundwater contamination. Tank Farm #4, also known as PRLT-18, is located within IC 28 in OU A.

2.1.2 Tank Farm #4

Tank Farm #4 was in operation from 1940 to the late 1980's. The site consisted of four 25,000 gallon underground fuel storage tanks (UFSTs), a truck filling station, and a truck receiving area (Figure 2.1). In 1956, two of the tanks contained motor vehicle gasoline (MOGAS) and two contained jet fuel. By 1976, all four tanks contained leaded regular gasoline. The site was identified as a potential source of contamination in 1986. By 1989,

FIGURE 2.1



two tanks were no longer in use and the two remaining tanks were used for military unleaded premium gasoline (MUP gas).

All four tanks and associated piping were removed in May 1992. Contamination was noted in soil along the fuel distribution piping at the southern ends of the tanks. The contaminated soil which was excavated during tank removal was subsequently placed back in the excavation. The area was graded and paved with asphalt approximately a year later and is currently used as a parking lot. A bioventing system was installed in July 1993 to remediate vadose zone fuel-hydrocarbon contamination.

2.2 HYDROGEOLOGY

2.2.1 McClellan AFB Hydrogeology

McClellan AFB is situated within the Sacramento Valley, a deep sedimentary trough of sediments shed from the Sierra Nevada mountains and transported by numerous tributaries to the meandering Sacramento River. The valley is covered by alluvial and fluvial deposits. These deposits are mostly fine-grained, but approximately 25 to 30 percent of the deposits are sand and gravel. Soils in the vicinity of the base are extremely variable, but are generally classified as fine, sandy loams. These soils have low shrink-swell potential and generally low soil permeabilities, varying locally.

The alternating layers of channels, overbank deposits, backwater deposits, sand bars, and widespread flood deposits today form an aquifer system that is extremely variable in nature over short distances, but broadly interconnected. This aquifer system has been separated into a series of zones for purposes of groundwater monitoring, and are designated A through E, from shallowest to deepest. Within OU A, the water table is typically between 100 and 125 feet below ground surface (bgs) (Jacobs 1995). Within the last ten years, the water table has been steadily declining at a rate between 1.25 and 2.0 feet per year due to over drafting by irrigation, supply, and extraction wells.

The aquifer zones are not hydraulically independent and groundwater can flow vertically between them. Horizontal groundwater movement in each zone is generally in a south-southwest direction, toward a regional pumping depression south of Sacramento. South and west of McClellan AFB numerous active private and public water supply wells influence the immediate subregional groundwater flow; therefore, groundwater flow directions on the base are dependent on location. The groundwater extraction systems installed at McClellan AFB during the 1980s also exert some local hydraulic control in the shallow aquifer zones.

A contaminant smear zone of residual and gaseous phase contaminants exists in the lower vadose zone due to changes in flow direction and the declining water table (Jacobs 1995). As groundwater levels declined, contaminant residuals have re-partitioned to the vadose zone as gases and some contaminants have remained adsorbed onto soil particles.

2.2.2 Tank Farm #4 Hydrogeology

Soil sampling activities at Tank Farm #4 have been conducted during tank excavation in May of 1992, as part of the Phase I RI for OU A in the fall of 1992 (Jacobs 1995), prior to installation of the bioventing system in July of 1993 (ES 1994), and after one year of bioventing operation (AFCEE 1995). The soil sampling locations are found on Figure 2.2. The total borehole depth for the borings completed during the above sampling events ranged from 21 feet to 40.5 feet below ground surface (bgs). The boring logs are included as Appendix A. No groundwater sampling has been conducted at tank Farm #4. However, upgradient and downgradient groundwater sampling within OU A has indicated that groundwater is between 100 and 125 feet bgs at Tank Farm #4.

The lithology is typical of the fluvial deposits found throughout OU A and consists of heterogeneous and discontinuous layers of silt, sandy silt, sand, silty sand, clay, and clayey sand. The maximum depth of the tank excavation in May 1992 and replaced fill material is estimated to be approximately 15 feet bgs. The bottom of the fill material ranged from 11 feet bgs in VW-1 to 18 feet bgs in VMP-2. Approximately 1.5 feet of hardpan was encountered in borehole VMP-3 at eight feet bgs. A geologic cross-section of soil sampling conducted in July of 1993 is shown on Figure 2.3.

2.3 PREVIOUS INVESTIGATIONS AT TANK FARM #4

2.3.1 Initial Site Investigations and UFST Removal: May 1992

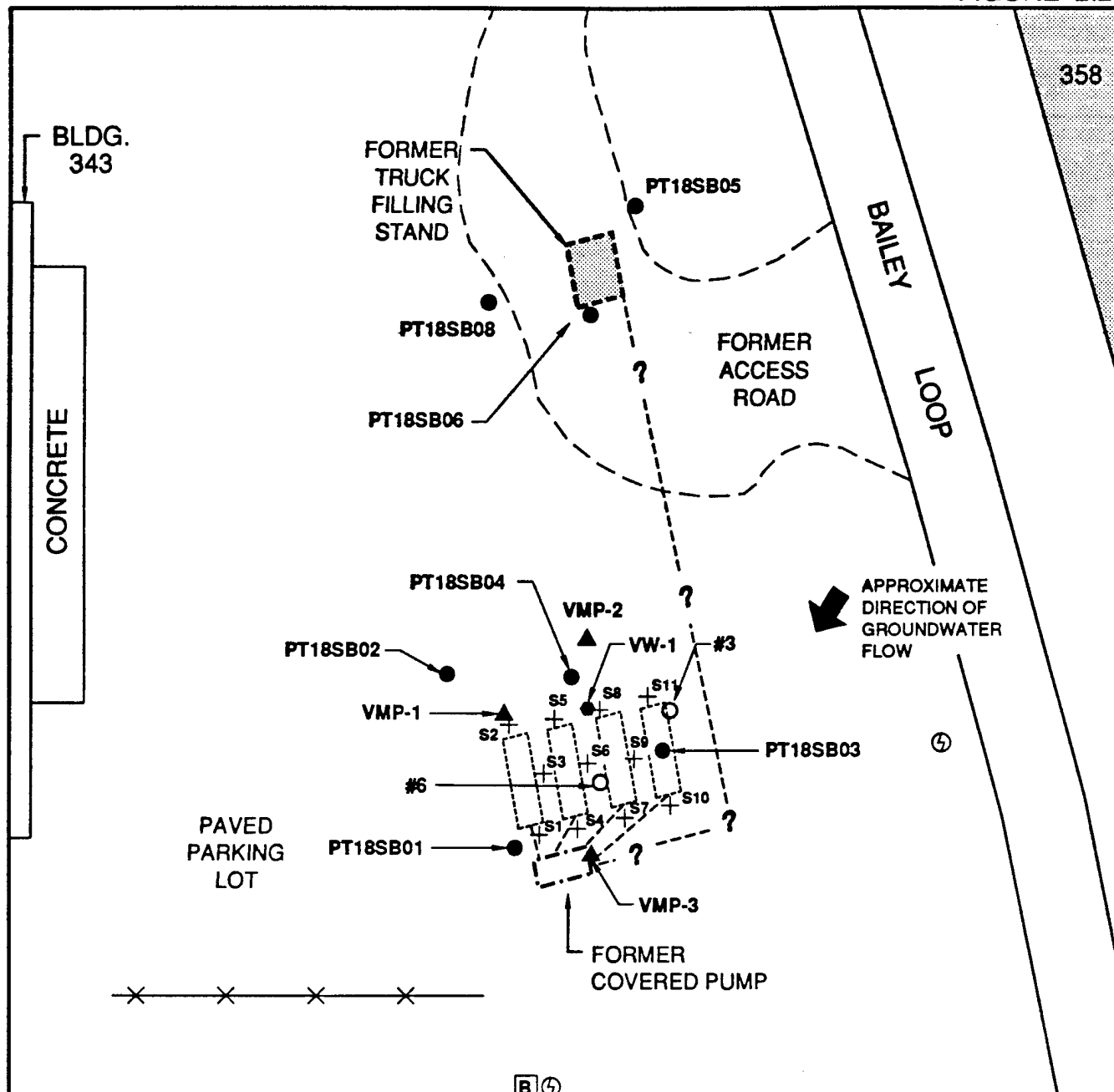
Eleven soil samples, S1 through S11, were taken from the bottom of the excavation pit, at approximately 15 feet bgs, during tank removal operations in May 1992. Soil samples were analyzed for total petroleum hydrocarbons (TPH), purgeable aromatics including benzene, toluene, ethylbenzene, and total xylenes (BTEX), and purgeable halocarbons. The analytical results for TPH and BTEX are listed in Table 2.1. The maximum levels of contaminants found were 3,470 mg/kg TPH-JP5, 4.57 mg/kg toluene, 7.25 mg/kg ethylbenzene, and 61.6 mg/kg total xylenes at sample location S1 near the location of the removed fuel distribution system piping. Contamination was also visibly observed in this area during tank removal operations. Soil sample locations S3, S5, S8, S9, and S11 showed evidence of contamination such as hydrocarbon odor and elevated PID readings but TPH and BTEX were not detected in soil samples. A concentration of 1.0 mg/kg 1,1,1-trichloroethane was detected at sample location S4 (Table 2.2). No other halogenated volatile organic compounds (VOCs) were detected.

2.3.2 Remedial Investigation: October 1992

Soil and soil vapor samples at Tank Farm #4 were collected as part of remedial investigations conducted at OU A in the fall of 1992. The Phase I RI at OU A was conducted from 1992 to 1995 (Jacobs 1995). The detected analytes in the soil and soil vapor samples are shown in Tables 2.1 through 2.4.

Soil samples were collected from seven soil boreholes (PT18SB01 through PT18SB06, PT18SB08). Borehole depth ranged from 21 to 23 feet bgs. with soil samples collected at approximately 10 feet bgs, 15 feet bgs, and 20 feet bgs. The soil samples were analyzed for

FIGURE 2.2



EXPLANATION

- PT18SB05
● SOIL BORING
- + S1
SOIL SAMPLE TAKEN FROM EXCAVATION PIT
- #3
ABANDONED SOIL BORING
- VW-1
VENT WELL
- ▲ VMP-1
SOIL VAPOR MONITORING POINT
- [B]
BLOWER LOCATION
- []
FORMER UNDERGROUND STORAGE TANK (UST)
- - -
FORMER FUEL LINES
- Ⓢ
POWER POLE
- x - x -
FENCE

SOURCE: MODIFIED FROM RADIAN (1990)

SOIL AND SOIL VAPOR SAMPLE LOCATIONS TANK FARM #4

McCLELLAN AIR FORCE BASE, CALIFORNIA



Table 2.1
Analytical Results for TPH and BTEX in Soil
Tank Farm #4
McClellan AFB, California

		Total Petroleum Hydrocarbons						Purgeable Aromatics ¹											
		8015 (Mod.)						8020 or 8240											
		Method:		TPH-g		TPH-JP5		TPH-d		TPH-mo		Benzene		Toluene		Ethylbenzene		Total Xylenes	
		Analyte:																	
Sample Dates	Contractor	Location		Concentrations in mg/kg															
		Boring No.	Depth (bgs)																
May-92	McClellan	S1	15 ²	NA	3,470	<20	<50	<0.05	4.57	7.25	61.6								
		S2	15 ²	NA	<10	<20	<50	<0.001	0.018	0.005	0.015								
		S3	15 ²	NA	<5	<10	<25	<0.001	<0.001	<0.001	<0.001								
		S4	15 ²	NA	<5	<10	<25	<0.05	0.070	0.18	0.28								
		S5	15 ²	NA	<5	<10	<25	<0.001	<0.001	<0.001	<0.001								
		S6	15 ²	NA	<5	<20	<50	<0.001	<0.001	<0.001	<0.001								
		S7	15 ²	NA	907	<20	<50	<0.050	0.123	0.193	1.85								
		S8	15 ²	NA	<10	<20	<50	<0.001	<0.001	<0.001	<0.001								
		S9	15 ²	NA	<10	<20	<50	<0.001	<0.001	<0.001	<0.001								
		S10	15 ²	NA	<10	<20	<50	<0.005	0.017	0.025	0.192								
		S11	15 ²	NA	<10	<20	<50	<0.001	<0.001	<0.001	<0.001								
Oct-92	Jacobs ^{3,4,5}	PT18SB01	10	750	NA	80	J	NA	<0.2	J	<0.2	J	7.7	J	7.2	J			
			15	1,600	NA	620	J	NA	<0.03	1	J	9.1	J	29	J				
			20	0.63	NA	NA	NA	<0.006	<0.006	J	<0.006	J	<0.006	J					
		PT18SB02	10	<0.1	NA	<11	NA	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006				
			15	<0.1	NA	<11	NA	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006				
			22	<0.1	NA	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				
		PT18SB03	10	0.98	J	NA	95	NA	<0.006	<0.006	<0.006	<0.006	0.034	J					
			15	<0.1	J	NA	11	JB	NA	<0.006	<0.006	<0.006	<0.01						
			20	<0.1	J	NA	NA	NA	<0.006	<0.006	<0.006	<0.01							
		PT18SB04	11	<0.1	J	NA	<11	NA	<0.006	<0.006	<0.006	<0.006	<0.01						
			15	<0.1	J	NA	<12	NA	<0.006	<0.006	<0.006	<0.01							
			20	<0.1	J	NA	NA	NA	<0.006	<0.006	<0.006	<0.01							
		PT18SB05	10	<0.1	J	NA	<12	NA	<0.006	<0.006	<0.006	<0.01							
			15	<0.1	J	NA	<11	NA	<0.007	<0.007	<0.007	<0.01							
			20	<0.1	J	NA	NA	NA	<0.006	<0.006	<0.006	<0.01							
		PT18SB06	5	6.5	J	NA	<12	NA	<0.006	J	<0.006	J	0.0063	J	<0.01	J			
10	0.73		J	NA	<12	NA	<0.006	<0.006	<0.006	<0.01									
15	<0.1		J	NA	NA	NA	<0.006	<0.006	<0.006	<0.01									
PT18SB08	10	<0.1	J	NA	<11	NA	<0.006	<0.006	<0.006	<0.01									
	15	<0.1	J	NA	<12	NA	<0.005	<0.005	<0.005	<0.01									
Jul-93	Parsons ES	VW-1	12.5	46	NA	NA	NA	<0.05	<0.05	<0.05	2.70								
		VMP-1	17.5	76	NA	NA	NA	<0.05	0.062	<0.05	0.47								
		VMP-2	20	<0.06	NA	NA	NA	<0.0003	<0.0003	<0.0003	<0.0007								
Sep-94	Parsons ES	VW-1	12.5	<5	NA	NA	NA	<0.069	<0.069	<0.069	<0.0140								
		VMP-1	17.5	<5	NA	NA	NA	<0.057	<0.057	<0.057	<0.110								
		VMP-2	20	<5	NA	NA	NA	<0.068	<0.068	<0.068	<0.140								

<12 - Below given reporting limit
 NA - Not Analyzed
 J - Estimated value
 JB - Estimated value due to blank contamination
 R - Value is rejected due to QC problems

TPH-d : Total Petroleum Hydrocarbons as diesel
 TPH-g : Total Petroleum Hydrocarbons as gasoline
 TPH-JP5 : Total Petroleum Hydrocarbons as JP5
 TPH-mo : Total Petroleum Hydrocarbons as motor oil

Notes:

- Purgeable aromatics for Oct. 1992 samples analyzed by both method 8020 and 8240. The highest reported value is shown. If the analyte was not detected, then the lowest reporting limit is shown.
- Samples collected from bottom of excavation; depth is estimated.
- Soil sample depths are approximate.
- No soil samples were collected from PT18SB07.
- Some soil samples collected in October 1992 were qualified due to QC problems (Jacobs 1995). Analytical results where QC problems were noted are qualified as being estimated.

Table 2.2
Other VOCs Detected in Soil
Tank Farm #4
McClellan AFB, California

Sample Dates	Contractor	Location		Analyte	Concentration (mg/kg)	Analytical Method
		Sample Location	Depth(bgs)			
May-92	McClellan	S4	15 ¹	1,1,1-Trichloroethane	1.00	8010
Oct-92 ²	Jacobs	PT18SB01	10	2-Methylnaphthalene	0.8	8270
			10	Naphthalene	0.4	8270
			15	2-Methylnaphthalene	4	8270
			15	Naphthalene	3	8270
			20	Acetone	0.061 J,TR	8240
			20	2-Methylnaphthalene	3	8270
			20	Naphthalene	3	8270

J - Estimated value
TR - Trace amount detected

Notes:

1. Samples collected from bottom of excavation; depth is estimated.
2. Soil samples where QC problems were noted are listed with the qualifiers J, TR.

Table 2.3
Analytical Results for TPH and BTEX in Soil Vapor
Tank Farm #4
McClellan AFB, California

				TPH	BTEX					Analytical Method	
				Analyte: TPH-g	Benzene	Toluene	Ethylbenzene	Total Xylenes			
Dates	Contractor	Location		ppmv							
		Boring No.	Depth(bgs)								
Oct-92	Jacobs ¹	PT18SB01	21	NA	92	J	<2	NA	261	J	E-18
		PT18SB02	23	NA	<2		<2	NA	14.8	J	E-18
		PT18SB03	21	NA	<0.050		<0.05	NA	1.01	N	E-18
		PT18SB04	21	NA	<0.1		<0.1	NA	0.48	J	E-18
		PT18SB05	21	NA	<0.2		<0.2	NA	5.50	N	E-18
		PT18SB06	21	NA	<0.5		<0.5	NA	10.60	J	E-18
		PT18SB08	21	NA	<0.5		<0.5	NA	<0.5		E-18
Jul-93	Parsons ES	VW-1 ²	10-25	1,900	<0.11		<0.11	4.80	5		TO-3
		VMP-1	17.5	5,200	<0.53		<0.53	11.00	12		TO-3
		VMP-3	20	10	<0.002		0.01	<0.002	0.021		TO-3
Sep-94	Parsons ES	VW-1 ²	10-25	12	<0.002		<0.002	0.04	0.098		TO-3
		VMP-1	17.5	48	<0.002		<0.002	<0.002	0.12		TO-3
		VMP-3	20	20	<0.005		<0.005	0.09	0.22		TO-3

<0.002 - Below given reporting limit
 NA - Not Analyzed
 J - Estimated Value
 N - Presumptive Identification

TPH-g - Total Petroleum Hydrocarbons as gasoline

Notes:

1. Soil vapor samples collected in October of 1992 were qualified as estimated due to QC problems (Jacobs 1995).
2. The soil vapor samples collected from VW1 is assumed to be drawn from the screened area of the well.

Table 2.4
Other VOCs Detected in Soil Vapor
Tank Farm #4
McClellan AFB, California

Dates	Contractor	Location		Analyte ¹	Concentration ²		Analytical Method
		Boring No.	Depth(bgs)		(ppmv)		
Oct-92	Jacobs	PT18SB01	21	1,1-DCE	3.8	IJ	E18
			21	Trans-1,2-DCE	85	I,N	E18
			21	TCE	0.7	INJ	E18
			21	Chloroform	0.67	INJ	E18
			21	Vinyl chloride	2.8	INJ	E18
		PT18SB02	23	TCE	4.3	NJ	E18
		PT18SB03	21	Freon 113	0.037	N	E18
			21	Freon 12	0.023	N	E18
			21	PCE	0.010	NJ,TR	E18
			21	TCE	0.051	N	E18
			21	Vinyl Chloride	0.056	INJB	E18
		PT18SB04	21	Trans-1,2-DCE	0.30	INJ	E18
			21	Freon 113	0.03	N	E18
			21	Freon 12	0.02	N	E18
			21	PCE	0.02	N	E18
			21	TCE	0.15	N	E18
			21	Chloroform	0.01	INJB	E18
		PT18SB05	21	1,1-DCE	0.21	NJB	E18
			21	Trans-1,2-DCE	0.25	NJ	E18
			21	Freon 113	0.02	NJ	E18
			21	PCE	0.21	N	E18
			21	TCE	0.03	N	E18
			21	Vinyl Chloride	0.38	INJB	E18
		PT18SB06	21	Trans-1,2-DCE	4.20	INJ	E18
			21	PCE	0.12	N	E18
			21	TCE	0.62	N	E18
			21	Vinyl Chloride	2.30	INJ	E18
		PT18SB08	21	PCE	0.63	N	E18
			21	TCE	0.41	N	E18
			21	Vinyl Chloride	0.60	IN	E18

I - Interference
J - Estimated value
JB - Estimated value due to blank contamination

TR - Trace amount detected
N - Presumptive Identification

Notes:

1. 1,1-DCE = 1,1-Dichloroethene; Trans-1,2-DCE = trans-1,2-Dichloroethene; TCE = Trichloroethene;
Freon 113 = 1,1,2-Trichloro-1,2,2-trifluoroethane; Freon 12 = Dichlorodifluoromethane;
PCE = Tetrachloroethene

2. Soil vapor samples where QC problems were noted are listed with the qualifiers I, J, JB, and N.

semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs) including BTEX, TPH-d, and TPH-g. TPH and BTEX compounds were detected in soil samples from three boreholes: PT18SB01, PT18SB03, and PT18SB06. The maximum concentrations were: 1,600 mg/kg TPH-g, 620 mg/kg TPH-d, 1 mg/kg toluene, 9.1 mg/kg ethylbenzene, and 7.2 mg/kg total xylenes, all at PT18SB01 at 15 feet bgs. PT18SB01 is located just southwest of the excavation in the area of the former fuel distribution piping. Low levels of 2-methylnaphthalene and naphthalene were reported in samples collected from PT18SB01, PT18SB03, and in PT18SB06 (Table 2.2). Several of the analytes detected in the soil samples were qualified as estimated due to quality control (QC) problems such as low matrix spike recovery, high or low laboratory control sample recoveries, and blank contamination.

Twenty-six shallow soil vapor screening samples were taken at approximately 5 feet bgs to evaluate the presence of VOC contamination in the gas phase at shallow depths. Samples were analyzed by SW8010/SW8020 using an onsite gas chromatograph. The highest concentrations of VOCs were located in the southern half of Tank Farm #4 and the maximum detected concentrations were 21,000 ppmv total volatile hydrocarbons, 0.112 ppmv TCE, and 0.03 ppmv PCE (Jacobs 1995).

One downhole soil vapor sample was taken at approximately 20 feet bgs at each of the seven soil borings completed during the remedial investigation. These samples were analyzed by Method E-18 and the analytes that were detected are listed in Tables 2.3 and 2.4. BTEX compounds were detected in six of the seven soil vapor samples and low levels of halogenated VOCs were detected in all soil vapor samples. The maximum detected concentration of benzene and total xylenes were 92 ppmv and 261 ppmv, respectively, at PT18SB01 where the maximum detections in soil samples were found.

Downhole soil vapor samples were taken by driving the soil probe through the center of the auger/drill pipe and collecting the sample in a Tedlar[®] bag. No confirmatory soil vapor samples were collected at Tank Farm #4. Based on other confirmatory soil vapor samples taken during remedial investigations analyzed by both Method E-18 and TO-14, Method E-18 data are biased high compared to Method TO-14 and Method E-18 is subject to significant numbers of false positives. In addition, TPH interference and blank contamination resulted in qualification of several of the detected analytes in soil vapor samples taken at Tank Farm #4 (Jacobs 1995).

2.3.3 Bioventing Pilot Test: 1993-1994

As part of the Air Force Bioventing Pilot Test Initiative Project, Parsons ES installed a bioventing system at Tank Farm #4 in July 1993 which included a bioventing air injection vent well (VW-1) and three vapor monitoring points (VMPs). The depth of the borehole at VW-1 was 31.5 feet bgs, and VW-1 was screened from 10 to 25 feet bgs. The depths of boreholes VMP-1, VMP-2, and VMP-3 were 25.5 feet, 30 feet, and 40.5 feet, respectively. Two additional boreholes were drilled and abandoned because contamination was not at sufficient levels for appropriate VMP or VW siting. The locations of the two abandoned soil borings (#3 and #6), VW-1, and the three VMPs are shown on Figure 2.2. A geologic cross

section of Tank Farm #4 based on boring logs from these boreholes including field OVA measurements and initial oxygen concentrations in soil gas is shown on Figure 2.3.

Air was injected into VW-1 at a flow rate of 25 standard cubic feet per minute (scfm) during the bioventing pilot test from August 1993 to September 1994. An air permeability test (AP) and an *in situ* respiration (ISR) test were conducted in August of 1993 and follow-up ISR tests were conducted in March and September 1994. Based on long-term monitoring results, the radius of influence due to air injection at VW-1 is greater than 30 feet at an air injection rate of 25 scfm. Based on the initial ISR test completed in August 1993, biodegradation rates ranged from 30 mg TPH per kg per year to 1,100 mg TPH per kg per year.

Since August 1993, the system has been in continuous operation at a flow rate of 25 scfm and maintained by McClellan AFB personnel. The system has shutdown occasionally for short periods of time due to power failures and minor maintenance problems.

Soil sampling and soil vapor sampling was completed during the initial bioventing system installation in July of 1993 and after one year of operation in September of 1994. Soil samples were collected at the three locations shown in Table 2.1 and analyzed for TPH-g and BTEX by Method 8015 (modified) and SW8020, respectively. Soil vapor samples were collected at the three locations shown in Table 2.3 and analyzed by EPA Method TO-3. Soil samples taken in July of 1993, prior to air injection, showed low levels of soil hydrocarbon contamination around VW-1 and VMP-1 where less than 100 mg/kg TPH-g and minor amounts of BTEX were detected. In addition, only moderate levels of contamination were found in soil gas at VW-1 and VMP-1 (1,900 ppmv TVH and 5,200 ppmv TPH, respectively).

In September of 1994, after the bioventing system had been in operation for approximately one year, soil and soil vapor sampling was conducted at the locations that were sampled previously in July of 1993. No TPH-g or BTEX compounds were detected in soil samples and no benzene was detected in soil vapor samples. Low levels of TPH-g and BTEX compounds, less than 50 ppmv and 0.313 ppmv, respectively, were detected in all three soil vapor samples. Follow up ISR testing conducted immediately prior to the soil and soil vapor sampling indicated that *in situ* respiration rates and biodegradation rates were lower and approaching background rates, consistent with the soil and soil vapor results that indicate contaminant mass has been reduced.

2.4 SUMMARY OF SITE CONTAMINANTS

The primary contaminants as shown by Tables 2.1 through 2.4 are fuel hydrocarbons. The highest concentrations of TPH and BTEX were detected in the southern portion of Tank Farm #4 near the location of the four removed UFSTs and fuel distribution lines. Confirmatory soil and soil vapor sampling after one-year of bioventing system operation showed that contaminant mass has been reduced. Groundwater is not expected to be currently impacted by the Tank Farm #4 site since groundwater throughout OU A is between 100 and 125 feet.

The highest levels of soil and soil vapor contamination were found at sample locations S1 and PT18SB01, respectively. The maximum level of soil contamination was found at 15 feet

bgs. Soil contaminant levels were significantly reduced or below detection at approximately 20 feet bgs in the seven soil borings completed in October of 1992.

The low levels of halogenated VOCs (HVOCs) detected in the soil vapor shown in Table 2.4 are probably due to other sites in the vicinity, volatilization from groundwater, or from the residuals within the groundwater smear zone and not a result of a source from the Tank Farm #4 site (Jacobs 1995). The bioventing system was not designed to remediate HVOCs but to remediate fuel-hydrocarbon contamination. Based on the soil and soil vapor sampling completed in September of 1994, fuel-hydrocarbon levels have decreased significantly as a result of extended bioventing operation. No TPH-g was detected in soil and less than 50 ppmv TPH-g was detected in the three soil vapor samples. No benzene was detected in soil or soil vapor samples. The system has been in operation since August of 1993 and it is expected that fuel hydrocarbons remaining in the soil have been further reduced during the past year of operation.

SECTION 3

**CRITERIA TO BE USED FOR NO FURTHER
INVESTIGATION RECOMMENDATION**

SECTION 3

CRITERIA TO BE USED FOR NO FURTHER INVESTIGATION RECOMMENDATION

No specific site cleanup standards apply to petroleum contaminated soils at McClellan AFB. The recommendation for NFI or for further site remediation will be made based on evaluating the proposed sampling and analysis results in accordance with principles set forth in the Tri-Regional Board staff recommendations for preliminary evaluation and investigation of underground tank sites (RWQCB, 1990) and the designated level methodology (Marshack, 1992). Both of these documents include methodology to evaluate the potential impact of residual soil contamination on groundwater. The potential impact to groundwater will also be evaluated based on the potential leachability of any contaminants as determined by the waste extraction test (WET) preparation method described in Section 4. The proposed soil vapor sample analytical results will be used as confirmation of soil results.

In addition, soil cleanup standards for petroleum-impacted sites listed in the interim site assessment and cleanup guidebook for the Los Angeles RWQCB (Los Angeles RWQCB, 1995) will be used as a guideline. While McClellan AFB is not within the Los Angeles RWQCB jurisdiction, this guidebook includes soil cleanup standards based on depth to groundwater and can aid in evaluating the results. The TPH-g and BTEX clean up standards in the Los Angeles guidebook for sites where groundwater is between 40 to 150 feet bgs is 100 mg/kg and 10 mg/kg, respectively.

SECTION 4

SAMPLING AND ANALYSIS PLAN

SECTION 4

SAMPLING AND ANALYSIS PLAN

The following SAP describes the sampling location, soil sampling procedures, and analytical methods proposed to collect sufficient data to support a recommendation of NFI of the Tank Farm #4 site.

4.1 SAMPLING LOCATIONS

Parsons ES proposes to drill a boring to a depth of at least 40 feet bgs as proposed in the OU A RI report (Jacobs 1995), near the southern end of former fuel tank and near the former fuel distribution piping (Figure 3.1). This location is near soil boring PT18SB01 and soil sample location S1 where the maximum concentration of fuel hydrocarbons was detected in prior investigations. The purpose of this additional boring will be to demonstrate that soil petroleum hydrocarbons have been reduced sufficiently to allow a recommendation of NFI of the Tank Farm #4 site and to evaluate the effectiveness of the bioventing system.

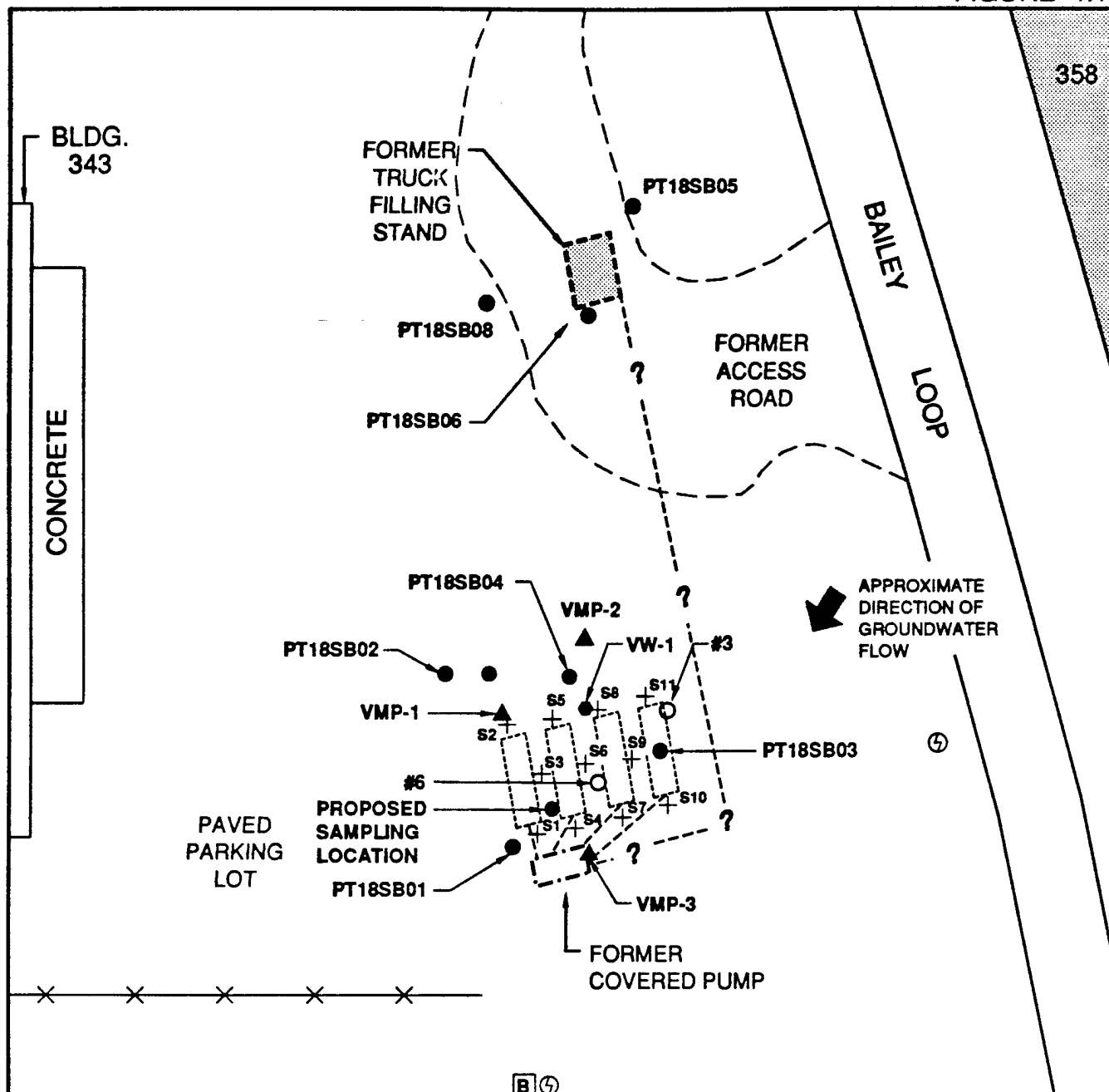
Four soil and two downhole soil vapor samples are proposed to be collected for laboratory analyses as recommended in the OU A RI. One downhole soil vapor sample and one soil sample will be collected from the bottom of the borehole. Additional soil samples are proposed to be taken at 10, 20 and 30 feet bgs and one additional soil vapor sample is proposed to be taken at 20 feet bgs. The actual sampling depths may be altered to allow samples to be collected from the most contaminated interval based on an evaluation of physical and visual evidence of contamination (e.g. odors, staining), site lithology, and headspace screening using both a hydrocarbon vapor analyzer and a photoionization detector. Additional soil and soil vapor samples may be collected if field observations indicate that the depth of contamination extends beyond 40 feet bgs. Soil and soil vapor samples will be collected and analyzed as described in Section 3.2 and 3.3, respectively.

In the unlikely event that analytical results indicate additional site remediation is required, VW-1 and the three VMPs will not be abandoned at this time. Should the NFI recommendation be approved, a recommendation will be made to properly abandon VW-1 and the three VMPs.

4.2 SOIL AND SOIL VAPOR SAMPLE COLLECTION

Boreholes will be advanced using a drill rig equipped with 6-inch outside-diameter (OD) hollow-stem auger. Relatively undisturbed soil samples, suitable for chemical analysis, will be collected at approximately 10-foot intervals. Soil samples will be collected in a 2.5-inch inside-diameter (ID) split-barrel sampler. The sampler will be lowered through the hollow

FIGURE 4.1



EXPLANATION

PT18SB05



SOIL BORING

S1



SOIL SAMPLE TAKEN FROM EXCAVATION PIT

#3



ABANDONED SOIL BORING

VW-1



VENT WELL

VMP-1



EXISTING SOIL VAPOR MONITORING POINT

[B]



BLOWER LOCATION



FORMER UNDERGROUND STORAGE TANK (UST)



FORMER FUEL LINES



POWER POLE



FENCE

SOURCE: MODIFIED FROM RADIAN (1990)

PROPOSED SAMPLING LOCATION AND PREVIOUS SOIL AND SOIL VAPOR SAMPLE LOCATIONS TANK FARM #4

MCCLELLAN AIR FORCE BASE, CALIFORNIA

PARSONS ENGINEERING SCIENCE, INC.

stem of the augers and driven approximately one to two feet into undisturbed soil ahead of the augers. The split-barrel sampler will be fitted with three pre-cleaned, 2.5-inch OD by 6-inch long, thin-walled, brass sleeves. After collection of a sample, the sampler will be retrieved, split apart, and the sleeves will be removed. The ends of the sleeves will be immediately capped with Teflon[®] tape and plastic endcaps. Samples will be labeled with the site name, borehole number, sample depth, and date and time of collection. The sleeves will be placed in an insulated shipping container with ice and will be maintained in a chilled condition.

Soil from some sleeves or from a continuous sampler will be used for soil headspace analysis. Each headspace screening sample will be placed in a sealed plastic bag and allowed to sit in the shade for at least 5 minutes. Soil headspace will then be determined using a total hydrocarbon vapor analyzer (THVA) and photoionization detector (PID). The soil headspace reading will be used in combination with downhole soil vapor readings to select samples for laboratory analysis. Soil samples selected for laboratory analysis will be shipped to Curtis and Tompkins of Berkeley, California, which has been audited by the U. S. Air Force and meets all quality assurance/quality control (QA/QC) and certification requirements for the State of California. A chain-of-custody form will accompany all samples.

Downhole soil vapor samples will be collected with a soil vapor probe consisting of a retractable tip and stainless steel mesh screen connected to the surface with dedicated tubing. The tip will be lowered through the hollow stem of the augers and driven approximately one to two feet into undisturbed soil, ahead of the augers. After the tip is in place, the probe rods will be raised to expose the screen and an air diaphragm pump at the surface will purge the tubing. *In situ* soil vapor samples will then be withdrawn for field and laboratory analysis prior to further advancement of the drill auger.

The vacuum and flow will be properly monitored and adjusted to prevent leakage of ambient air into the sampling system. After purging the probe tubing, the tubing and air pump will be connected to a vacuum chamber at the ground surface holding a 3-liter Tedlar[®] sample bag (described in Section 2.5 of Addendum One to the protocol document). The chamber will then be evacuated with the air pump, filling the bag with the soil vapor sample. Soil vapor samples will be analyzed in the field with an oxygen/carbon dioxide meter, a THVA, and a PID. Soil vapor samples will also be collected in Summa canisters from the same Tedlar[®] bag sample used for field analysis. The techniques described above will minimize purging and sample collection activities, prevent ambient air leakage into samples, and ensure that field and laboratory analyses are performed on the same representative sample.

Soil vapor samples will be labeled with the site name, borehole number, sample depth, and date and time of collection. The Summa[®] canisters will not be chilled to prevent condensation of hydrocarbons. Soil vapor samples will be shipped to Air Toxics, Ltd. of Folsom, California which meets all QA/QC and certification requirements for the State of California. A chain-of-custody form will accompany all samples.

Boreholes will be logged by a Parsons ES geologist. The geologist will be responsible for observing all field investigation activities, maintaining a detailed descriptive log of all subsurface materials recovered during soil coring, and properly labeling and storing samples.

After sampling is complete, each sampling location will be restored as closely to its original condition as possible. Boreholes will be sealed with bentonite chips, pellets, or grout to eliminate any creation or enhancement of contaminant migration pathways to the groundwater. Asphalt patch will be used to finish surface completion as close to the parking lot grade as practicable.

4.3 SAMPLE ANALYSES

Parsons ES proposes to analyze soil samples for total purgeable hydrocarbons (TPH-g) and total extractable hydrocarbons quantified as both TPH-d and TPH-JP-5 (fuel scan analysis) by modified Method SW8015 and BTEX by EPA Method 8020. Soil samples will also be analyzed for soluble petroleum hydrocarbons using the waste extraction test (WET) preparation method described in California Administrative Code (CAC) Title 22, article 11, section 66700 (C through F) except that the extraction solution for the WET test shall consist of deionized water. Soil vapor samples will be analyzed for TPH-g, TPH-jet fuel, and BTEX by EPA Method TO-3.

4.4 EQUIPMENT DECONTAMINATION AND DISPOSAL OF INVESTIGATION DERIVED WASTE

4.4.1 Soil Cuttings

All drill cuttings from the additional borehole will be gathered and containerized on site in labeled U.S. DOT-approved 55-gallon drums. The drums will be labeled with the site name, drilling date, borehole number, and depth intervals. The drums will be placed on pallets provided by McClellan AFB and base personnel will be notified at the end of each day. No drums will be transported off site by Parsons ES or the drilling contractor. Base personnel are responsible for disposing of soil cuttings.

4.4.2 Decontamination Rinse Water

Prior to arriving at the site, probe rods, tips, sleeves, pushrods, samplers, tools, and other downhole equipment will be decontaminated using a high-pressure, steam/hot water wash. Only potable water will be used for decontamination. Between collection of each soil sample and downhole soil gas sample, the sampling barrel and probe tip will be disassembled and decontaminated with Alconox and potable water, then swabbed with isopropyl alcohol. The barrel will then be rinsed with deionized water and reassembled with new liners. Potable water to be used during equipment cleaning, decontamination, or grouting will be obtained from one of the Base water supplies. The preferred method of disposal for the decontamination rinse water will be discharge to the base treatment plant.

4.5 QUALITY CONTROL AND QUALITY ASSURANCE

The McClellan AFB Basewide RI/FS Quality Assurance Project Plan (QAPP) Final which establishes guidelines and standard operating procedures (SOPs) to be followed during investigations at the Base (Radian, 1994) will be followed.

SECTION 5

REPORT FORMAT

SECTION 5

REPORT FORMAT

Following receipt of the laboratory analytical results, a short Letter Report will be prepared and submitted to the RWQCB, the DTSC, McClellan AFB, and AFCEE.

The report will contain the following information:

- Plot plans showing final borehole location;
- Summary of field activities;
- Assessment of analytical results;
- Laboratory analytical reports and chain-of-custody forms;
- Borehole logs; and
- Conclusions and recommendations for no further investigation or additional cleanup action in comparison to criteria presented in Section 3.

SECTION 6

PROJECT SCHEDULE

SECTION 6

PROJECT SCHEDULE

The following schedule is based on anticipated time requirements for regulatory reviews and approvals.

<u>EVENT</u>	<u>DATE</u>
Preliminary Draft SAP to McClellan AFB and AFCEE	22 December 1995
Comments to Preliminary Draft SAP due from McClellan AFB and AFCEE	19 January 1996
Parsons ES marks locations of additional boring	5 January 1996
Final SAP to McClellan AFB, AFCEE, RWQCB, and DTSC	26 January 1996
Digging permit due from McClellan AFB for proposed sampling location	5 February 1996
Field work/drilling/sampling	13 February 1996
Letter Report of sampling results and recommendation to McClellan AFB and AFCEE	1 April 1996

SECTION 7

REFERENCES

SECTION 7

REFERENCES

AFCEE 1992, Test Plan and Technical Protocol for a Field Treatability Test for Bioventing. Brooks Air Force Base, Texas. May

AFCEE 1994, Addendum One to Test Plan and Technical Protocol for A Field Treatability Test for a Field Treatability Test for Bioventing Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential. Brooks Air Force Base, Texas. February

AFCEE 1995, Letter from AFCEE to Mr. Mario Ierardi dated 13 April 1995, Subject: Completion of One Year Bioventing Tests: Tank Farm #2; Tank Farm #4; SA-6; PRL-T-46; Davis Communications Center

Engineering Science, Inc. 1994, Part I: Bioventing Pilot Test Workplan for Tank Farm #2, Tank Farm #4, SA 6, PRL T-46, Building 720 McClellan AFB, California and Davis Global Communications Site, Davis, California and Part II: Draft Bioventing Pilot Test Interim Results for Tank Farm #2, Tank Farm #4, SA 6, PRL T-46, Building 720 McClellan AFB, California and Davis Global Communications Site, Davis, California. Prepared McClellan AFB and AFCEE. February

Jacobs Engineering Group 1995, Operable Unit A Interim Basewide Remedial Investigation Draft Final, Part 2A - Site Characterization Summary/Field Sampling Plan. Prepared for McClellan AFB and AFCEE. August

Marshack, John 1992, California's Water Quality Standards and Their Applicability to Waste Management and Site Cleanup. California Water Quality Standards Bulletin. August

Radian Corporation 1992, Installation Restoration Program Stage 7, Preliminary Groundwater Operable Unit Remedial Investigation. September

Radian Corporation 1994, McClellan AFB Quality Assurance Project Plan. Prepared for McClellan AFB Environmental Management. Final. November

Regional Water Quality Control Board North Coast Region, San Francisco Region, and Central Valley Region 1990, Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites. August

APPENDIX A

GEOLOGIC BORING LOGS







LOG OF BORING PT18SB1

PROJECT NAME: MCCLELLAN AIR FORCE BASE - DU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 05G10700		LOCATION IDENTIFIER: PT18SB1	
thing: 360995.93 Easting: 2174721.84		Elevation and Datum: 76.00 ft above mean sea level (app.)	
Health and Safety: Level D with Tyvek		Date Started: 10/23/92	Date Finished: 10/23/92
Drilling Equipment: CME 750		Total Depth (feet): 21.00	Depth to Groundwater (feet): Dry
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring Well Total Depth (feet): NA	As-Built In Figure: NA
Hammer Information: 140 lb with 30 in drop		Logged by: TL	Checked by: SMG <i>SMG</i>

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	DVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00						GC		GRAVEL with some fines, not sampled	
								CLAY: 7.5YR3/2 dk brown, not sampled	
3.513	67.00				423.00	SH			
5.00								SILTY SAND: 10YR3/2 vry dk gry brown, fn to md sand w/ app 25% silt, moist, str HC odor	
21.5050	67.00			MC-A005228 MC-A007652 MC-A001051	558.00	SM		SILTY SAND: 10YR4/4 dk yllw brown, vry fn to fn sand w/ app 20% silt, dry, indurated, dense, str HC odor	
20.2743	83.00			MC-A005229 MC-A001053	444.00	SP			
15.00								SAND: 10YR4/3 dk brown, fn to crs subrnd sand, md sorted, moist, dense, str HC odor, (tank backfill?)	
20.1838	83.00			MC-A005234 MC-A001055	310.00	SP		SAND: 10YR4/4 gry brown, fn to md subrnd md to well sorted sand, moist, dense, str HC odor (tank backfill?)	
21.00				MC-A005236					







LOG OF BORING PT18SB2

PROJECT NAME: MCCLELLAN AIR FORCE BASE - DU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 05610700		LOCATION IDENTIFIER: PT18SB2	
thing: 361037.86 Easting: 2174706.33		Elevation and Datum: 76.00 Ft above mean sea level (a),	
Health and Safety: Level D with Tyvek		Date Started: 10/23/92	Date Finished: 10/23/92
Drilling Equipment: MOBILE B53		Total Depth (Feet): 23.00	Depth to Groundwater (Feet): Dry
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring Well Total Depth (Feet): NA	As-Built In Figure: NA
Hammer Information: 140 lb with 30 in drop		Logged by: TL	Checked by: SMG <i>SMG</i>

Depth (Feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00						SPH		GRAVEL: not sampled	
								CLAY: dk brown, not sampled	
5.00	5 6 8	67.00			0.00	SC		CLAYEY SAND 5YR3/3 dk rdsh brown, 30% sticky low pl clay, moist, soft, no odor	
10.00	15 32 50	67.00		MC-A005231 MC-A001081 MC-A001082	2.00	ML		SANDY SILT 7.5YR4/6 str brown, 20% vry fn to fn sand w/ app 5% crs subrnd sand, dry, dense, cohesive, no odor	
15.00	20 60 60	63.00		MC-A005232 MC-A001083	0.00	SM		SILTY SAND 7.5YR4/6 str brown, fn to crs poorly sorted sand w/ app 20% silt, dry, vry dense, no odor	
20.00	13 40 42	0.00			0.00			NO RECOVERY	
	20 33 44	67.00		MC-A005233 MC-A005235 MC-A001085	0.00	SM		SILTY SAND: 7.5YR/6 str brown, vry fn to fn mica sand w/ app 15% silt, dry, dense, no odor	
25.00				MC-A005237					







LOG OF BORING PT18SB3

PROJECT NAME: MCCLELLAN AIR FORCE BASE - DU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 05610700		LOCATION IDENTIFIER: PT18SB3	
thing: 361017.28 Easting: 2174758.30		Elevation and Datum: 76.00 ft above mean sea level (app.)	
Health and Safety: Level D with Tyvek		Date Started: 10/23/92	Date Finished: 10/23/92
Drilling Equipment: MOBILE B53		Total Depth (feet): 21.00	Depth to Groundwater (feet): Dry
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring Well Total Depth (feet): NA	As-Built In Figure: NA
Sampler Information: 140 lb with 30 in drop		Logged by: TL	Checked by: SMG <i>SMG</i>

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00						GC		GRAVEL: 10YR3/2 vry dk gry brown, med silt and fn to md sand	
								CLAY: dk brown, not sampled	
11.18 22.39 00					0.00	ML		SANDY SILT: 10YR3/2 vry dk gry brown, 15% fn to md sand w/ app 5-10% grvl to 1cm, low pl, moist, non sticky, no odor	
10.14 21.34 00				MC-A001087 MC-A001088	31.00	ML		SANDY SILT: same as above with app 5-10% grvl to 2cm, sl HC odor	
8.10 12.44 00				MC-A001089 MC-A001090 MC-A005240	20.00	ML		SANDY SILT: same as above	
21.22 49.100 00				MC-A005242 MC-A005241 MC-A001091 MC-A005238	20.00	ML		SANDY SILT: 2 5Y5/4 lt olv brn, 15% vry fn to fn sand, dry, no odor, med dense, some FeOx staining	

LOG OF BORING PT18SB4

PROJECT NAME: MCCLELLAN AIR FORCE BASE - DU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 05610700		LOCATION IDENTIFIER: PT18SB4	
-thing: 361038.63 Easting: 2174737.35		Elevation and Datum: 76.00 ft above mean sea level.	
Health and Safety: Level D with Tyvek		Date Started: 10/26/92	Date Finished: 10/26/92
Drilling Equipment: MOBILE B53		Total Depth (feet): 21.00	Depth to Groundwater (feet): Dry
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring Well Total Depth (feet): NA	As-Built In Figure: NA
Hammer Information: 140 lb with 30 in drop		Logged by: TL	Checked by: SMG <i>SMG</i>

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0 00						GC CL		GRAVEL Not sampled.	
								CLAY: Not sampled	
5 00	22 56 50	67 00			62 00	SM		SILTY SAND: 10YR3/3 dk brown, fn to md poorly sorted sand w/ app 20% silt and 5% rnd grvl to 1cm, dry, vry dense, sl HC odor, some soil discoloration	
10 00	9 15 22	67 00		MC-A005243 MC-A001093 MC-A001094	0 00	SM		SILTY SAND same as above, except no grvl	
15 00	7 11 15	83 00		MC-A005244 MC-A001094 MC-A001095	0 00	SM		SILTY SAND: same as above	
20 00	18 25 35	83 00		MC-A005246 MC-A001097 MC-A005245	0 00	ML		SANDY SILT: 2.5Y5/4 lt olv brown, app 15% vry fn to fn sand, dry, non pl, dense, FeOx staining, no odor	
25 00				MC-A005281					

LOG OF BORING PT18SB5

PROJECT NAME: MCCLELLAN AIR FORCE BASE - DU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 05610700		LOCATION IDENTIFIER: PT18SB5	
SHEET: 1 of 1			
thing: 361156.65 Easting: 2174750.54		Elevation and Datum: 76.00 Ft above mean sea level (app.)	
Health and Safety: Level D with Tyvek		Date Started: 10/26/92	Date Finished: 10/26/92
Drilling Equipment: MOBILE B 53		Total Depth (feet): 21.50	Depth to Groundwater (feet): Dry
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring Well Total Depth (feet): NA	As-Built In Figure: NA
Hammer Information: 140 lb with 30 in drop		Logged by: TL	Checked by: SMG <i>SMG</i>

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	GVH Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00	0 0 0	0.00			0.00	GC		GRAVEL: Not sampled	
17.27	40	100.00			40.00	CL		SANDY CLAY 10YR4/3 dk brown, app 25% md to cns sand and 5-10% subrnd grvl to 5mm, moist, pl, hard, str HC odor at sampler shoe	
13.18	20	83.00		MC-A005273 MC-A001100	146.00	ML		SANDY SILT 10YR4/4 dk yllw brown, 15% vry fn sand, dry, md dense, sl HC odor	
9.14	22	67.00		MC-A005274 MC-A001102	250.00	SP		SAND 5Y6/5 pl olive, vry fn to md sand, md sorted, moist, subang, sl HC odor, 10% rounded black sand	
32.60	60	67.00		MC-A005276 MC-A001103 MC-A005275 MC-A005282	0.00	ML		SILT: 10YR4/4 dk yllw brown, app 5% fn sand and 5-10% clay, dry, non pl, dense, cohesive w/ blocky structure, no odor	

LOG OF BORING PT18SB6

PROJECT NAME: MCCLELLAN AIR FORCE BASE - DU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 05610700		LOCATION IDENTIFIER: PT18SB6	
thing: 361129.86 Easting: 2174738.52		SHEET: 1 of 1	
Elevation and Datum: 76.00 ft above mean sea level			
Health and Safety: Level D with Tyvek		Date Started: 10/26/92	
Date Finished: 10/26/92			
Drilling Equipment: MOBILE B53		Total Depth (feet): 21.00	
Depth to Groundwater (feet): Dry			
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Monitoring Well		As-Built	
Sampling Method: 18 inch Split-Spoon Sampler		Total Depth (feet): NA	
In Figure: NA			
Hammer Information: 140 lb with 30 in drop		Logged by: TL	
Checked by: SMG			

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0 00						GC		GRAVEL Not sampled	
4 6 11 67 00				MC-A005276 MC-A005275 MC-A001106	165 00	CL		SILTY CLAY 7 SYR3/2 dk brown, app 20% silt and 5-10% fn sand, moist, md pl, soft, HC odor	
10 16 28 63 00				MC-A005280 MC-A005279 MC-A001106	110 00	ML		SANDY SILT 10YR5/6 yllw brown, app 20% fn sand, moist, md dense, sl HC odor	
20 21 23 83 00				MC-A005277 MC-A005278 MC-A005279	181 00	SM		SILTY SAND 2.5Y5/3 lt olv brown, vry fn to md sand w/ app 15% silt, moist, non pl, md dense, sl HC odor	
50 50 0 67 00				MC-A005283	43 00	SM		SILTY SAND 2.5Y5/3 lt olv brown, vry fn to fn sand w/ app 25% silt, sl moist, non pl, vry dense, no odor	

LOG OF BORING PT18SB8

PROJECT NAME: MCCLELLAN AIR FORCE BASE - DU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 05610700		LOCATION IDENTIFIER: PT18SB8	
SHEET: 1 of 1			
-thing: 361132.97 Easting: 2174713.31		Elevation and Datum: 76.00 ft above mean sea level (app.)	
Health and Safety: Level D with Tyvek		Date Started: 10/27/92	
Date Finished: 10/27/92			
Drilling Equipment: MOBILE B 53		Total Depth (feet): 21.00	
Depth to Groundwater (feet): Dry			
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Monitoring Well		As-Built	
Total Depth (feet): NA		In Figure: NA	
Sampling Method: 18 inch Split-Spoon Sampler			
Hammer Information: 140 lb with 30 in drop		Logged by: TL	
Checked by: SMG		SMG	

[illegible]

BOREHOLE NUMBER: 1 (VMP-3)

PROJECT NUMBER: DE 268.36.04 / 47.04	PROJECT NAME: BIOVENTING INITIATIVE
CLIENT: AFCEE	DRILLER: BEYLIK DRILLING
LOCATION: McCLELLAN AFB, CALIFORNIA	DRILLING METHOD: HOLLOW-STEM AUGER
TANK FARM #4	
GEOLOGIST: FRIZABETH ROSENBERG	HOLE DIAMETER: 8 IN.
COMPLETION DATE:	TOTAL DEPTH: 40.5 FT. BGS

DEPTH feet	SAMPLE LOCATION	SAMPLE NUMBER	BLOW COUNT	PID (ppm) (THVA) (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
							ASPHALT
							GRAVEL (fill material)
5				68 [0]			SAND: silty, clayey, red-brown, sl; loose, sl plastic.
				13 [0]			SAND: clayey, brown, sl plastic. Moist @ 6 to 7 ft. bgs.
10							HARD PAN CONTACT
				23 [0]			SAND: silty, yellow-brown, hard, white streaks, loose to med hard.
15				0 [0]			A/A with some indurated fragments and some gravel.
				11 [18]			A/A, tan fine-grained, crumbles easily.
20				7 [8]			A/A
				0 [4]			CLAY: sandy, tan w/reddish streaks, sl hard.
25				0 [8]			SILT: sandy, tan-brown w/streaks of rust, organics, hard.
				0 [14]			SAND: silty, tan-brown, some coarse-grained sand and pebbles.
30				0 [NR]			



- Equilibrated waterlevel.



- First encountered groundwater.



- Brass tube sample submitted for laboratory analysis

BOREHOLE NUMBER: 1 (VMP-3)

PROJECT NUMBER: DE 268.36.04 / .47.04	PROJECT NAME: BIVENTING INITIATIVE
CLIENT: AFCEE	DRILLER: BEYLIK DRILLING
LOCATION: McCLELLAN AFB, CALIFORNIA	DRILLING METHOD: HOLLOW-STEM AUGER
TANK FARM #4	
GEOLOGIST: ELIZABETH ROSENBERG	HOLE DIAMETER: 8 IN.
COMPLETION DATE:	TOTAL DEPTH: 40.5 FT. BGS.

DEPTH feet	SAMPLE LOCATION	SAMPLE NUMBER	BLOW COUNT	PID (ppm) [THVA] (A/A)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
35							A/A No recovery
40				[D] [D] [D]			A/A SAND: 'clean'. SILT: clayey, hard, tan-brown.
45							
50							
55							
60							

 - Equilibrated waterlevel.

 - First encountered groundwater.

 - Brass tube sample submitted for laboratory analysis

BOREHOLE NUMBER: 2(VW-1)

PROJECT NUMBER: DE 268.36.04 / 47.04	PROJECT NAME: BIOVENTING INITIATIVE
CLIENT: AFCEE	DRILLER: BEYLIK DRILLING
LOCATION: MCCLELLAN AFB CALIFORNIA TANK FARM #4	DRILLING METHOD: HOLLOW-STEM AUGER
GEOLOGIST: ELIZABETH ROSENBERG	HOLE DIAMETER: 8" → REAMED TO 11"
COMPLETION DATE:	TOTAL DEPTH: 31.5 FT. BGS

DEPTH feet	SAMPLE LOCATION	SAMPLE NUMBER	BLOW COUNT	PTD (ppm) (TVA) (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
							ASPHALT
							CLAY: Gravelly (up to 3cm. diam - rounded).
5							
				59 [48]			SILT: Gravelly, brown with gray discoloration. Some odor.
							No recovery.
10							
		TF4-BH2- 12.5		1883 [1400]			SILT: Gravelly, brown, w/ blue-green discoloration, Fuel odor.
							SAND: Silty, blue-green discolor. 13.0-14.5 FT. BGS.
15				2769 [2100]			SILT: Sandy, blue-green discoloration, strong Fuel odor.
				43 [44]			SAND: silty, tan, layers of blue-green discoloration.
							SAND: silty with pieces of organics and streaks of Fe staining.
20				6 [4]			19.0-19.5' layer of blue-green discoloration w/ Fuel odor.
				11 [30]			silty SAND / sandy SILT interbedded. Beds are 2-3 in. thick. Laminations of Fe staining and blue-green discoloration. mild fuel odor.
							A/A w/ abundant organics.
25				0 [0]			A/A, poor recovery, very mild fuel odor.
				0 [0]			No recovery.
30				0 [0]			SILT: Sandy, brown, mod hard, abund. organics.

↑ FILL ↓

- ▼ - Equilibrated waterlevel.
- ▼ - First encountered groundwater.

■ - Brass tube sample submitted for laboratory analysis

BOREHOLE NUMBER: 3 (Abandoned)

PROJECT NUMBER: DE 268.36.04 / 47.04	PROJECT NAME: BIOVENTING INITIATIVE
CLIENT: AFCEE	DRILLER: BEYLIK DRILLING
LOCATION: McCLELLAN AFB, CALIFORNIA	DRILLING METHOD: HOLLOW-STEM AUGER
TANK FARM #4	
GEOLOGIST: ELIZABETH ROSENBERG	HOLE DIAMETER: 8 in.
COMPLETION DATE:	TOTAL DEPTH: 25.0 FT. BGS.

DEPTH feet	SAMPLE LOCATION	SAMPLE NUMBER	BLOW COUNT	PID (ppm) (THVA) (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
							ASPHALT
5				0 [0]			SILT: Gravelly, brown (pts) A/A w/minor gray discoloration. A/A with no discoloration, brown.
10				0 [0]			SAND: silty, brown, minor gravel and wood fragments. A/A.
15				8 [0]			SAND: silty, tan, hard, abundant horizontal Fe staining laminations, abundant organics.
20				5 [16]			silty SAND / sandy SILT interbedded: tan-brn, abundant Fe-stained laminations, abundant organics w/white streaks, sand crumbles easily.
25				6 [24]			A/A with increasing silt and clay with depth - increasingly stiff.
				7 [16]			
				7 [8]			SILT: clayey, tan-brn, silty plastic.
30							

FILL

- ▼ - Equilibrated waterlevel.
- ▼ - First encountered groundwater.

- - Brass tube sample submitted for laboratory analysis

BOREHOLE NUMBER: 4 (VMP-1)

PROJECT NUMBER: DE 268.36.04 / .47.04	PROJECT NAME: BIOVENTING INITIATIVE
CLIENT: AFCEE	DRILLER: BEYLIK DRILLING
LOCATION: McCLELLAN AFB, CALIFORNIA TANK FARM #4	DRILLING METHOD: HOLLOW-STEM AUGER
GEOLOGIST: ELIZABETH ROSENBERG	HOLE DIAMETER: 8 IN.
COMPLETION DATE:	TOTAL DEPTH: 25.0 FT. BGS

DEPTH feet	SAMPLE LOCATION	SAMPLE NUMBER	BLOW COUNT	PID (ppm) (MVA) (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
							ASPHALT.
5				53 [4]			SAND: gravelly, silty, brown, sli moist. A/A with minor blue-green discoloration @ 4 FT BGS. A/A with mild Fuel Odor.
10				48 [30]			No recovery.
15				21 [10]			A/A.
				620 [28]			SAND: clayey, silty, brown, sli plastic, gray discoloration at 14.5 FT BGS. Fuel Odor.
		TF4- BH4- 17.5		1538 [1800]			A/A w/ blue-green discoloration and Fuel Odor. stiff, but crumbles easily.
20				30 [4]			SILT: sandy, clayey, brown-green, minor Fe stains, horiz. fractures. Fuel Odor. Hard brown silt layer 19.5-20.0 FT BGS.
				42 [35]			SILT: Tan w/ brown color, stiff, Fuel Odor.
25				12 [0]			SAND: silty, tan w/ brn-green. Fuel Odor. A/A w/ minor organics.
30							

FILL

 - Equilibrated waterlevel.

 - First encountered groundwater.

 - Brass tube sample submitted for laboratory analysis

BOREHOLE NUMBER: 5 (JMP-2)

PROJECT NUMBER: DE 268.36.04 / .47.04	PROJECT NAME: BIOVENTING INITIATIVE
CLIENT: AFCEE	DRILLER: BEYLIK DRILLING
LOCATION: McCLELLAN AFB, CALIFORNIA	DRILLING METHOD: HOLLOW-STEM AUGER
TANK FARM #4	
GEOLOGIST: ELIZABETH ROSENBERG	HOLE DIAMETER: 8 IN.
COMPLETION DATE:	TOTAL DEPTH: 30.0 FT. BGS

DEPTH feet	SAMPLE LOCATION	SAMPLE NUMBER	BLOW COUNT	PID (ppm) (TVA) (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
5				59 [82]			ASPHALT. SAND: gravelly and silty, brown. A/A w/ faint fuel odor. A/A w/ clay, faint fuel odor, some gray discoloration.
10				35 [24]			A/A.
15				19 [30]			A/A.
				25 [42]			A/A.
				15 [16]			A/A.
20		TF4- BH5- 20		69 [52]			SAND: clayey, silty, tan w/ blue-green, fuel odor.
				52 [18]			silty SAND / clayey SILT interbedded (1cm thick), Fe stained laminations, hard layer @ 21 FT, tan-brn w/ minor gray color.
25				26 [23]			SILT: sandy, clayey, tan-brown, Fe-stain laminations, organics.
				74 [200]			CLAY: sandy, tan-brown, organics, Fe staining laminations.
30				0 [0]			A/A.
				4 [2]			

 - Equilibrated waterlevel.

 - First encountered groundwater.

 - Brass tube sample submitted for laboratory analysis

BOREHOLE NUMBER: (6) - Abandoned

PROJECT NUMBER: DE 268.36.04 / .47.04	PROJECT NAME: BIOVENTING INITIATIVE
CLIENT: AFCEE	DRILLER: BEYLIK DRILLING
LOCATION: McCLELLAN AFB, CALIFORNIA	DRILLING METHOD: HOLLOW-STEM AUGER
TANK FARM #4	
GEOLOGIST: ELIZABETH ROSENBERG	HOLE DIAMETER: 8 IN.
COMPLETION DATE:	TOTAL DEPTH: 22.5 FT. BGS

DEPTH feet	SAMPLE LOCATION	SAMPLE NUMBER	BLOW COUNT	PTD (ppm) (TWA) (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
							ASPHALT
5				200 [48]			SAND: gravelly and silty, brown.
				165 [4]			SILT: gravelly, sandy, clayey.
10				36 [0]			A/A, moist @ 8.5 FT, dry @ 9.5 FT.
				7 [14]			A/A.
15				4 [18]			SILT: clayey, sandy, 1cm thick layers of tan-bn silt, silty plastic.
				7 [13]			SILT: sandy, brown, hard.
20				0 [14]			A/A.
				0 [0]			
25							
30							

FILL

 - Equilibrated waterlevel.

 - First encountered groundwater.

 - Brass tube sample submitted for laboratory analysis